

## ABSTRACT OF THE DISCLOSURE

Described herein is a method for constructing a multipurpose error-control code for multilevel memory cells operating with a variable number of storage levels, in particular for memory cells the storage levels of which can assume the values of the set  $\{b^{a_1}, b^{a_1 a_2}, \dots, b^{a_1 a_2 \dots a_h}\}$ , with  $b, a_1, \dots, a_h$  positive integers; the error-control code encoding information words, formed by  $k$   $q$ -ary symbols, *i.e.*, belonging to an alphabet containing  $q$  different symbols, with  $q \in \{b^{a_1}, b^{a_1 a_2}, \dots, b^{a_1 a_2 \dots a_h}\}$ , in corresponding code words formed by  $n$   $q$ -ary symbols, with  $q = b^{a_1 a_2 \dots a_h}$ , and having an error-correction capacity  $t$ , each code word being generated through an operation of multiplication between the corresponding information word and a generating matrix. The construction method comprises the steps of: acquiring the values of  $k, t, b^{a_1}, b^{a_1 a_2}, \dots, b^{a_1 a_2 \dots a_h}$ , which constitute the design specifications of said error-control code; calculating, as a function of  $q = b^{a_1}, k$  and  $t$ , the minimum value of  $n$  such that the Hamming limit is satisfied; calculating the maximum values  $\hat{n}$  and  $\hat{k}$  respectively of  $n$  and  $k$  that satisfy the Hamming limit for  $q = b^{a_1}, t$  and  $(\hat{n} - \hat{k}) = (n - k)$ ; determining, as a function of  $t$ , the generating matrix of the abbreviated error-control code  $(n - k)$  on the finite-element field  $GF(b^{a_1})$ ; constructing binary polynomial representations of the finite-element fields  $GF(b^{a_1}), GF(b^{a_1 a_2}), \dots, GF(b^{a_1 a_2 \dots a_h})$ ; identifying, using the aforesaid exponential representations, the elements of the finite-element field  $GF(b^{a_1 a_2 \dots a_h})$ , which are isomorphic to the elements of the finite-element fields  $GF(b^{a_1}), GF(b^{a_1 a_2}), \dots, GF(b^{a_1 a_2 \dots a_h})$ ; establishing biunique correspondences between the elements of the finite-element fields  $GF(b^{a_1}), GF(b^{a_1 a_2}), \dots, GF(b^{a_1 a_2 \dots a_h})$  and the elements of the finite-element field  $GF(b^{a_1 a_2 \dots a_h})$  that are isomorphic to them; and replacing each of the elements of said generating matrix with the corresponding isomorphic element of the finite-element field  $GF(b^{a_1 a_2 \dots a_h})$ , thus obtaining a multipurpose generating matrix defining, together with the aforesaid biunique correspondences, a multipurpose error-control code that can be used with memory cells the storage levels of which can assume the values of the set  $\{b^{a_1}, b^{a_1 a_2}, \dots, b^{a_1 a_2 \dots a_h}\}$ .